UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/773,818	02/06/2004	Teruhisa Shibahara	36856.1213	7932

54066 7590 08/21/2006

MURATA MANUFACTURING COMPANY, LTD.
C/O KEATING & BENNETT, LLP
8180 GREENSBORO DRIVE
SUITE 850
MCLEAN, VA 22102

EXAMINER	
SUMMONS, BARBARA	

ART UNIT	PAPER NUMBER
2817	

DATE MAILED: 08/21/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/773,818	SHIBAHARA ET AL.	
	Examiner	Art Unit	
	Barbara Summons	2817	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 August 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-65* is/are pending in the application.

4a) Of the above claim(s) *13-65* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-12* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) *1-65* are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *06 February 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of Species I, including claims 1-12, in the reply filed on 8/14/06 is acknowledged.

2. Claims 13-65 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to nonelected Species, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on 8/14/06.

Double Patenting

3. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

4. Claims 1-10 and 12 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claim 14 of U.S. Patent No. 6,879,086.

Although the conflicting claims are not identical, they are not patentably distinct from each other because claim 14 of the '086 patent includes signal wiring lines/traces (see the last three lines of claim 14) on an insulating layer between the signal traces and the piezoelectric substrate, wherein these signal traces surround a ground electrode (see claim 10, lines 12-19) such that a portion of the signal traces where the wiring traces have different potentials face each other in plan view will be on the insulation layer and the rest of the conductor patterns forming transducers of the SAW devices are on the piezoelectric substrate, not the insulating layer. Regarding claims 3-7, the relative permittivity of an insulating pattern of less than about 4 and a piezoelectric of 20 or more would have been the inherent values of well known art recognized materials, resin would have been an art recognized alternative insulating material as would the various piezoelectric materials recited (see also US '086 claim 17), and the thickness of the insulating layer would have been easily determined by one of ordinary skill in the art. Regarding claims 8, 9 and 12, such SAW filters would have been extremely well known to operate at the recited frequencies and one of their main intended uses is in communication devices. Regarding claim 10, SAW filters with balanced/unbalanced conversion functions also would have been extremely well known (see also US '086 claim 15).

5. Claims 1-10 and 12 are directed to an invention not patentably distinct from claim 14 of commonly assigned U.S. 6,879,086 for the reasons given in the immediately preceding paragraph.

The U.S. Patent and Trademark Office normally will not institute an interference between applications or a patent and an application of common ownership (see MPEP Chapter 2300). Commonly assigned U.S. 6,879,086, discussed above, would form the basis for a rejection of the noted claims under 35 U.S.C. 103(a) if the commonly assigned case qualifies as prior art under 35 U.S.C. 102(e), (f) or (g) and the conflicting inventions were not commonly owned at the time the invention in this application was made. In order for the examiner to resolve this issue, the assignee can, under 35 U.S.C. 103(c) and 37 CFR 1.78(c), either show that the conflicting inventions were commonly owned at the time the invention in this application was made, or name the prior inventor of the conflicting subject matter.

A showing that the inventions were commonly owned at the time the invention in this application was made will preclude a rejection under 35 U.S.C. 103(a) based upon the commonly assigned case as a reference under 35 U.S.C. 102(f) or (g), or 35 U.S.C. 102(e) for applications pending on or after December 10, 2004.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. § 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the

applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 1-4, 6-10 and 12 are rejected under 35 U.S.C. § 102(e) as being anticipated by Takamine U.S. 6,879,086.

The applied reference has a common inventor with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

Regarding claims 1, 3, 4, 6 and 7, Figs. 31 and 32 of Takamine disclose a SAW filter comprising a piezoelectric substrate 301 that can be lithium tantalate (see e.g. claim 10) that inherently has a relative permittivity of about 20 or more since this in merely an inherent property of the material; an insulating pattern 1401/1402, that is disclosed as being a resin such as polyimide (see col. 15, lines 40-44) which inherently has a relative permittivity of less than about 4 since this is merely an inherent property of the material that is less than the piezoelectric substrate (see col. 15, lines 53-55); a conductor pattern that defines IDTs of filters 201/202 (see cover figure) and wiring traces 304-307 (signal) and 302/303 (ground); and at a portion where wiring traces having different potentials signal/ground face each other in a plan view, at least a portion, in this case all, of the wiring traces 304-307 and 302/303 are disposed on the insulating pattern 1401/1402.

Regarding claim 2, a first conductor pattern that forms the IDTs is disposed on the piezoelectric substrate, and a second conductor pattern 304-307 and 302/303 which is in conduction with the first conductor pattern is disposed on the insulating pattern 1401/1402. Regarding claims 8 and 9, see Takamine at col. 6, lines 55-60. Regarding claim 10, see Takamine at e.g. claim 15. Regarding claim 12, see Takamine Fig. 34.

8. Claims 1-3, 6-8 and 10-12 are rejected under 35 U.S.C. § 102(a) as being anticipated by Nakamura et al. JP 2003-332874.

The English language equivalent document U.S. 7,046,102 will be referenced in the following discussion.

Regarding claims 1 and 2, Fig. 11 of Nakamura et al. discloses a SAW filter comprising a piezoelectric substrate 200; an insulating pattern 204 disposed on the piezoelectric substrate has a relative permittivity less than that of the piezoelectric substrate (see col. 5, lines 8-11); a conductor pattern disposed on the substrate such that a first conductor defines IDT electrodes 210-230 and a second conductor in conduction with the first conductor defines wiring traces 283, 284 and 292 and ground wiring traces (not numbered); and at a portion where wiring traces having different potentials face each other in a plan view (i.e. where 284 is adjacent to ground traces from IDTs 220 and 230), at least a portion of one of the wiring traces 284 is disposed on the insulating pattern 204 (see col. 15, lines 1-6).

Regarding claim 3, the insulating pattern 204 is disclosed as silicon oxide (see col. 21, lines 65-67) that inherently has the material property of a relative permittivity of

about 4 or less (see other art of record as evidence. e.g. Takeno applied below). Regarding claims 6 and 7, see col. 5, lines 15-18 and col. 22, lines 19-24. Regarding claim 8, see col. 9, lines 24-27. Regarding claims 10 and 11, the elements 263 and 264 in Fig. 11a are balanced terminals and element 272 is an unbalanced terminal, and the wiring traces 283, 284 and 292 to each of these terminals are disposed on the insulating pattern 204. Regarding claim 12, see Fig. 16.

9. Claims 1-3, 6-9 and 12 are rejected under 35 U.S.C. § 102(b) as being anticipated by Matsuda JP 2000-138553 (cited by Applicants).

Regarding claims 1-3, 6 and 7, Fig. 1 of Matsuda discloses a SAW filter comprising: a piezoelectric substrate 1 that is lithium tantalate or lithium niobate (see section [0018] of the attachment 1 machine translation) each of which has the inherent material property of a relative permittivity greater than 20 (see e.g. Takeno applied below as evidence); an insulating pattern 8 disposed on the piezoelectric substrate and being silicon dioxide (see section [0021] of the translation) that has the inherent material property of a relative permittivity that is less than that of the piezoelectric substrate and that is about 4 or less; and a conductor pattern shown in Fig. 4 that has a first conductor pattern that defines input/output IDTs 2a and 2b of the IIDT filter 2 and is disposed on the piezoelectric substrate where the insulating layer is not (see Fig. 3), and a second conductor pattern that defines signal wiring traces 6 that connect to lattice filter L (Fig. 1) and the shorter ground wiring traces between them (i.e. connected to ground 4 in Fig. 1) that are in conduction with the first conductor pattern IDTs, and wherein at the portion

where the wiring traces 6 and the short ground wires between them face each other in plan view, these wiring traces are all disposed on the insulating pattern 8 as can be seen in Fig. 3. Regarding claims 8 and 9, see section [0025] and section [0033] of the translation. Regarding claim 12, see section [0001] of the translation.

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. § 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

11. Claims 5 and 9 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Nakamura et al. JP 2003-332874 taken alone.

Nakamura et al. discloses the invention as discussed above, except for explicitly disclosing a thickness of the insulating pattern being about 0.5 micron or more or the operating frequency being about 1 GHz or more.

Nakamura et al. does disclose using a different thickness for the insulating layer than the normalized thickness in the example given (see col. 12, line 49-51), and also discloses that the thicker the insulating layer the more the parasitic capacitance will be reduced (see Fig. 7)[see also col. 11, line 23 to col. 12, line 48] and discloses that the thickness of the insulating film/layer F depends on the frequency of design as well as bandwidth required etc. (col. 12, lines 25-29).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the SAW filter of Nakamura et al. such that the operating frequency would have been 1 GHz or more and/or the insulating pattern would have had a thickness of 0.5 micron or more, because Nakamura et al. explicitly suggested using other thicknesses for the insulating layer (col. 12, lines 49-51) and also suggested using other frequencies those above 1 GHz being extremely well known in the SAW filter art, and wherein the thickness of the insulating pattern would have been dependent upon the frequency and bandwidth requirements of the individual devices as also suggested by Nakamura (col. 12, lines 25-29) one of ordinary skill in the art being easily able to make the selections based on the individual application.

12. Claims 1, 3, 5-7 and 12 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Takeno et al. U.S. 4,065,734 in view of Ieki et al. U.S. 4,037,181.

Figs. 1A and 3A of Takeno et al. discloses a SAW filter for e.g. a television video communication device (see col. 1, lines 14-15) comprising: a piezoelectric substrate 11 of lithium niobate or lithium tantalate with a relative permittivity of greater than 20 (see

col. 5, lines 10-12 and col. 6, lines 12-16); an insulating pattern 12 of e.g. silicon monoxide or dioxide with a lower relative permittivity of about 4 or less and a thickness of 1 micron (see col. 5, lines 12-15); a conductor pattern the whole of which is disposed on the insulating pattern, and wherein the conductor pattern defines IDTs 13 and 14.

However, Takeno does not explicitly show wiring traces such that where wiring traces with different potentials face each other in plan view, at least one is disposed on the insulating pattern. Note that since the whole device is on the insulating pattern, the presence of wiring traces would disclose the entire claimed feature.

Ieki et al. shows the same general transversal type SAW filter (Fig. 1) and explicitly shows wiring traces for connecting the IDTs to terminals 4-7 wherein 4 and 5 are necessarily of opposite potentials to excite the IDT 2.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the SAW filter of Takeno et al. (Fig. 1A), if even necessary, to have had wiring traces for connecting the IDTs 13 and 14 to terminals for connection to external devices as suggested by the exemplary teaching thereof by Ieki et al. (Fig.1), because such an obvious modification would have been, if not inherently necessary, at least an art recognized equivalent means to connect the device to terminals for connection to outside circuitry, as would have been known by one of ordinary skill in the art.

Conclusion

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Nakamura et al. U.S. 6,930,570 discloses a SAW filter with balanced and unbalanced terminals (see the abstract) and that reduces parasitic capacitance by placing wiring lines on different planes, wherein one is on the piezoelectric and another is on an insulating layer (see Figs. 18 and 19).

Kuroda U.S. 6,404,303 discloses a SAW filter with wiring lines 22 (see Fig. 9) having portions formed on an insulating layer 23.

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Barbara Summons whose telephone number is (571) 272-1771. The examiner can normally be reached on M-Th, M-Fr.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bob Pascal can be reached on (571) 271-1769. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

bs
August 16, 2006
(1 Attachment)

Barbara Summons

BARBARA SUMMONS
PRIMARY EXAMINER

* NOTICES * Attachment 1

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the surface acoustic wave filter of an unbalance balance conversion mold especially about the frequency band filter built in mobile wireless devices, such as a land mobile radiotelephone and a cellular phone.
[0002]
[Description of the Prior Art] One or more ctenidium-like electrodes (it is Inter Digital Transducer and they are the following and IDT it abbreviates to an electrode) of a pair are arranged on a piezo-electric substrate, and the basic configuration of conventional surface acoustic wave (it abbreviates to SAW below Surface Acoustic Wave :) equipment is this IDT. It is excited [SAW] from an electrode. On a propagation path, it is SAW. The reflector for making it resonate efficiently is arranged in those both ends.
[0003] IDT An electrode and a reflector are 36degreeY. Cut X On the piezo-electric substrate which consists of a propagation lithium tantalate single crystal etc., they are aluminum and aluminum-Cu by the thin film forming methods, such as vacuum deposition and a spatter. Electric conduction objects, such as an alloy, are formed and produced by the detailed electrode pattern by the photolithography method.
[0004] Moreover, it is SAW by the use components mark reduction for small and lightweight-izing of this mobile communication equipment etc., and low-cost-izing. Addition of a new function is demanded of the filter. It is SAW in which the electrical connection of an unbalanced input-balanced output or a balanced input-unbalanced output is possible to the balanced I/O edge of the mixer IC which performs a down convert and rise convert of a carrier transmitting number frequency to one of them. A filter (the following and balanced type SAW it is called a filter) is desired. Moreover, in order to change, it doubles with this resistance, and the rated resistance by which termination is carried out at a balanced edge with Mixer IC is a balanced type SAW. It is necessary to design balanced end connection resistance of a filter.
[0005] The conventional SAW Since it is the connection structure which can generally perform only an unbalanced input-unbalanced output (see JP,5-183380,A etc.), a filter is SAW. It connects through balanced - unbalance converter called a balun between a filter and Mixer IC.
[0006] Moreover, balanced type SAW As a filter, as shown in drawing 11 , in order to raise the magnitude of attenuation out of band, the surface acoustic wave filter J0 which connected two resonator mold filters 71 and 72 to mirror symmetry is known (see JP,8-65094,A etc.). Since it constitutes so that the energy of SAW may make it accumulate into a resonator mold filter and may form especially the band-pass filter of RF block although it can respond to balanced I/O in such a resonator mold filter, it is IDT. Thereby, although the pitch of the ctenidium of an electrode must be made very small and must be carried out, when power is impressed to RF block, a filter shape may deteriorate in the migration of an electrode and it becomes a big problem on dependability.
[0007] In order to solve these troubles, it is SAW first. Compound resonator mold SAW made to constitute using many resonators in order to have distributed the power impressed to a filter Filter structure, Balanced type SAW As a filter, it is IDT. Multi-electrode which laid the electrode every other I/O (by Inter-degitated Inter Digital Transducer) a following and IIDT electrode -- omitting -- it is

necessary to make it compound, to constitute and to distribute an electrical potential difference, and it necessary to raise power-proof nature

[0008] Moreover, an IIDT electrode is IDT. Much configurations of an electrode come out, for a certain reason, wiring with aluminum wire and Au wire which were performed from the former is complicated, and area also with the great pad section which connects an IIDT electrode to this wire is needed.

[0009] Then, these people are IDT for an input of plurality [top / piezo-electric / substrate 51], as shown in drawing 6 . Electrode 52a and two or more IDT(s) for an output To the input or output side of the IIDT electrode 52 installed by turns, electrode 52b Two or more IDT(s) The lattice mold circuit L or two or more IDT(s) which connected surface acoustic wave resonator 53 which consist of an electrode in the shape of a symmetry grid The surface acoustic wave filter J which connects the ladder mold circuit which connected the surface acoustic wave resonator which consists of an electrode in the shape of a ladder, and changes is proposed. In addition, for an input electrode and 55, as for the input-side solid wiring section and 57, an earth electrode and 56 are [54 / the output side solid wiring section and 58] an insulating layer and the electrode of a balanced output pair [62 / the input electrode of the lattice mold circuit L and / 61 and 62 / 60 / 59 and].

[0010]

[Problem(s) to be Solved by the Invention] However, when making solid wiring connection of the above filters, as first shown in drawing 7 , IIDT52 and the surface acoustic wave resonator 53 are formed on the piezo-electric substrate 51. Next, since it is the structure which forms on it the insulating layer 58 shown in drawing 8 , and finally forms the input electrode 54 shown in drawing 9 , an earth electrode 55, the input electrodes 59 and 60 of a skeleton pattern electrode, one electrode 61 of a balanced output pair, and another electrode 62 of a balanced output pair If an insulating layer 58 was not moderately thick, it becomes impossible for the effectiveness of layer insulation to have demonstrated enough, and when the insulating layer 58 on each surface acoustic wave resonator was too thick conversely, there was a problem that a filter shape will deteriorate.

[0011] Moreover, if in the case of the above-mentioned structure wiring etc. is formed after protecting by the insulating layer 58 after formation of a ctenidium electrode, since membrane formation of an electrode material and the process of etching will be once made by the insulating layer 58 on a ctenidium electrode, the front face of an insulating layer 58 is surely etched, and the problem of a frequency changing arises.

[0012]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the surface acoustic wave filter of this invention To the input or output side of an IIDT electrode which installed two or more IDT electrodes for an input, and two or more IDT electrodes for an output by turns The lattice mold circuit which connected the surface acoustic wave resonators which consist of two or more IDT electrodes in the shape of a symmetry grid, Or connect the ladder mold circuit which connected the surface acoustic wave resonator which consists of two or more IDT electrodes in the shape of a ladder through a circuit pattern, and it changes. The electrode extension section of an IIDT electrode, said lattice mold circuit, or a ladder mold circuit is characterized by being arranged on the insulating layer prepared on the circuit pattern and this circuit pattern.

[0013] Moreover, it is characterized by coming to carry out the laminating of the protective layer which satisfies the following type on an IIDT electrode, a lattice mold circuit, or a ladder mold circuit.

[0014] 1x109 Omega<=rho/h <=1x1013ohm (however, resistivity of rho:protective layer, h: thickness) Moreover, the manufacture approach of the surface acoustic wave filter of this invention To the input or output side of an IIDT electrode which installed two or more IDT electrodes for an input, and two or more IDT electrodes for an output by turns The lattice mold circuit which connected the surface acoustic wave resonators which consist of two or more IDT electrodes in the shape of a symmetry grid, Or it is the manufacture approach which connects the ladder mold circuit which connected the surface acoustic wave resonator which consists of two or more IDT electrodes in the shape of a ladder, and changes. The process which forms the circuit pattern which connects an IIDT electrode, a lattice mold circuit, or a ladder mold circuit, It is characterized by performing the process which forms the process which forms an insulating layer in the field except a connection with an IIDT electrode, a lattice mold circuit, or a ladder mold circuit at least and an IIDT electrode and a lattice mold circuit, or a ladder mold circuit one by one.

[0015]
[Embodiment of the Invention] SAW concerning this invention The operation gestalt of a filter is explained to a detail based on a drawing.
[0016] As shown in drawing 1 , it is SAW of this invention. A filter S1 To the input or output side of the IIDT electrode 2 installed by turns, two or more IDT electrode 2a for an input, and two or more IDT electrode 2bs for an output The ladder mold circuit which connected the surface acoustic wave resonator which consists of the lattice mold circuit L or two or more IDT electrodes which connected surface acoustic wave resonator 3 which consist of two or more IDT electrodes in the shape of a symmetry grid in the shape of a ladder is connected through a circuit pattern, and it changes. Moreover, as shown in drawing 5 , the electrode extension sections 6 and 7 of the IIDT electrode 2, the lattice mold circuit L, or a ladder mold circuit are arranged on the insulating layer 8 prepared on circuit patterns 4, 5, 9, 10, and 11, 12, and these circuit patterns.
[0017] Moreover, as shown in drawing 5 , the laminating of the protective layer 15 may be carried out on the IIDT electrode, the lattice mold circuit L, or the ladder mold circuit.
[0018] Here, the piezo-electric substrate 1 is a 36 degree**3 degreeY propagation lithium niobate single crystal and 45 degree**3 degreeX cut Z. Cut X A propagation lithium tantalate single crystal and 42degree**3degreeY Cut X A propagation lithium tantalate single crystal and 64degree**3degreeY A cut X propagation lithium niobate single crystal and 41degree**3degreeY Cut X A propagation tetraboric-acid lithium single crystal etc. can use it suitably, and since [that an electromechanical coupling coefficient is large and] these piezo-electric substrates have the small frequency temperature coefficient, they are desirable. The thickness of this piezo-electric substrate 1 has about 0.1-0.5 goodmm, and by less than 0.1mm, a piezo-electric substrate cannot become weak, by 0.5mm **, ingredient cost and a components dimension become large and it cannot be used.
[0019] Moreover, IDT An electrode 2 and a reflector 13 consist of aluminum or aluminum alloy (aluminum-Cu a system and aluminum-Ti system etc.), and are vacuum deposition, the sputtering method, or CVD. It forms by the thin film forming methods, such as law. And IDT An electrode 2 is about 30-200 pairs of logarithms, and IDT. An electrode pitch is 0.4 micrometers - about 20 micrometers, and crossover width of face (aperture width) is 10 micrometers - about 500 micrometers and IDT. For electrode thickness, it is SAW to be referred to as 0.1 micrometers - about 0.5 micrometers. It is suitable when acquiring the property as a filter.
[0020] For 4, as for the circuit pattern for earth electrodes, and 6, the circuit pattern for input electrodes and 5 are [the input-side solid connection wiring section and 7] the earth side solid connection wiring sections. An electrical signal is added to the IIDT electrode 2 with the structure in which added RF electrical signal to the circuit pattern 4 for input electrodes, and the circuit pattern 5 for earth electrodes, and solid wiring was carried out by such configuration.
[0021] moreover, the insulating layer 8 -- SiO 2, SiN, or aluminum 2O3 etc. -- it considers as the insulating thin film which consists of one or more sorts.
[0022] Moreover, SAW concerning this patent They are Si, SiO 2, SiN, and aluminum 2O3 to the SAW propagation section on the electrode of a filter element, and a piezo-electric substrate. It is good to form as a protective layer 15 and to perform the energization prevention and the improvement in power-proof by the conductive foreign matter. Here, the thickness of a protective layer 15 has 15nm - desirable 75nm. If thinner than 15nm, the function as a protective layer will not be achieved, and if thicker than 75nm, the problem that the insertion loss of a filter becomes large will arise.
[0023] Moreover, when resistivity of the protective layer at this time is set to rho and thickness is set to h, inter-electrode discharge according that rho/h is 1x109 to 1x1013ohms to pyroelectricity can be prevented.
[0024] Moreover, the above-mentioned surface acoustic wave filter S1 is manufactured according to the following processes at least. First, as shown in drawing 2 , the process which forms the circuit patterns 4, 5, 9, 10, 11, and 12 which connect the IIDT electrode 2, and the lattice mold circuit L or a ladder mold circuit is performed. Next, the process formed in a pattern as shows an insulating layer 8 at least to the field except the connection of the IIDT electrode 2, and the lattice mold circuit L or a ladder mold circuit at drawing 3 is performed. And as shown in drawing 4 , it is made to perform the process which forms the IIDT electrode 2, and the lattice mold circuit L or a ladder mold circuit.
[0025] According to the surface acoustic wave filter S1 obtained in this way, as shown in drawing 10 ,

the very good property that the deflection in a band is small was acquired from the magnitude of attenuation in the normalized radiam frequency (value which divided the frequency by center frequency) in the range of 800MHz - 2.5GHz center frequency at least.

[0026]

[Example] As shown in drawing 1 , the resonator of the grid connection of an IIDT electrode mold with an output side was arranged to the input side, and these wiring performed the design which facilitated wiring with a wire according to 6 of drawing 1 , and the structure of 7. The electrode line breadth of an IIDT electrode is 1.1 micrometers, and the line breadth of the IDT electrode of the serial arm resonator constituted by the skeleton pattern is 1.05 micrometers, and line breadth of the IDT electrode of a grid arm resonator was set to 1.1 micrometers. Moreover, electrode layer thickness is 3200A and the average lambda of a total ctenidium-like electrode pitch and the ratio with the electrode layer thickness h of a ctenidium-like electrode could be 7.4%.

[0027] The concrete production approach is explained below.

[0028] 42degreeY Cut X It produced by forming the circuit pattern which covers said structure and said resonator electrode detail on the piezo-electric substrate which consists of a propagation lithium tantalate single crystal. a resist is applied to the substrate washed first by about 1-micrometer thickness -- N2 BEKU was performed in the ambient atmosphere.

[0029] Next, ultraviolet rays (Deep-UV) They are much SAW(s) on a substrate by the photolithography method by the used adhesion exposure machine. The negative pattern of the resist of a filter was formed. At this time, the photo mask used the thing with a thickness of 0.25 inches.

[0030] Next, aluminum was formed with the electron-beam-evaporation machine on the negative pattern. Then, lift off of the unnecessary aluminum was carried out in resist exfoliation liquid, and aluminum electrode pattern of the gross shape shown in drawing 2 was produced. Next, the sputtering method SiO2 Membranes were formed.

[0031] then, a resist is applied by about 1-micrometer thickness -- N2 BEKU was performed in the ambient atmosphere. Next, ultraviolet rays (Deep-UV) The resist was formed on the substrate by the photolithography method by the used adhesion exposure machine at the pattern of drawing 3 . CF4 O2 It is RIE with the gas used as a principal component A deed and SiO2 Patterning was carried out.

[0032] Next, aluminum was formed with the electron-beam-evaporation machine. The again same photolithography technique as the above is used, and they are much SAW(s). The pattern of the resist of a filter was formed. Etching of aluminum BCl3 Cl2 N2 Gas is used and it is RIE. It carried out by law. Then, lift off of the unnecessary aluminum is carried out in resist exfoliation liquid, and it is IDT. Detailed circuit patterns, such as an electrode, were produced. Then, IDT The electrode was connected to the network analyzer and the frequency characteristics of an insertion loss were measured.

[0033] consequently, the range of 800MHz - 2.5GHz center frequency -- setting -- the deflection in a band -- 1.2dB it is -- the good property was able to be acquired.

[0034]

[Effect of the Invention] Since solid wiring was made to be carried out in an insulating layer and an electrode layer after formation of a circuit pattern according to the surface acoustic wave filter and its manufacture approach of this invention as explained above, an insulating layer can be made thick enough and interelectrode capacity can be made small. Moreover, function sufficient as a layer insulation layer can be given, and the outstanding surface acoustic wave filter can be offered.

[0035] Moreover, the surface acoustic wave filter which was excellent in the dependability which an insulating layer is not exposed to the etching process of a detailed IDT electrode, and does not have property change, such as frequency change, can be offered.

[0036] Furthermore, when it is not necessary to prepare a thick insulating layer on a surface acoustic wave resonator and there are no worries about degradation of the property by this, the surface acoustic wave filter which was excellent in dependability or a property can be offered by forming the protective layer optimal on a surface acoustic wave resonator.

[Translation done.]